Performance evaluation of organic and conventional potato *(Solanum tuberosum* L.) production in the West Region of Cameroon: An economic policy review

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ABSTRACT

Aims: To describe the socio-economic characteristics of potato producers, compare the performance and identify production challenges of organic and conventional potato production in the West region of Cameroon.

Study design and methodology: The study population refers to the conventional and organic potato producers in the West region of Cameroon. Purposive and snowball sampling technique were used in this study. A total sample size of 200 respondents was identified, 148 conventional farmers and 52 organic farmers. Out of 200 farmers interviewed, 55 from Mifi division (11 organic and 44 conventional) and 145 from Menoua division (41 organic and 104 conventional).

Results: Results revealed that majority of potato producers in the West region of Cameroon are male, 70.3% conventional farmers and 88.5% organic farmers. Most farmers are married (73% conventional and 78.9% organic farmers) and practiced livestock rearing in addition to potato production. Also, most farmers (59.5% conventional farmers and 59.6% organic farmers) have secondary education as their highest level of formal education. Information on yield revealed a productivity gap and production cost between conventional and organic potato farmers with a positive mean difference of 7,102.877kg and 765,184 frs respectively, significant at 5% level in favour of conventional farmers. Similarly, results showed a gap in revenue and gross margin between the two categories of farmers with a positive mean difference of 1,233,240 frs and 465,475.4 frs respectively, significant at 5% level in favour of conventional farmers. Analysis showed that 50% of conventional farmers interviewed noted rainfall variation as the main challenge faced in production while 80% of organic farmers have low seed quality as the main challenge.

Conclusion: Conventional potato farmers are better off than organic potato farmers in terms of yield and gross margins, thus bringing to limelight the question concerning the popular push of organic foods consumption as regard potato.

Keywords: Organic farming; conventional farming; performance; yield; gross margin.

1. INTRODUCTION

In Cameroon, agriculture is one of the main occupations providing employment for more than 70% of the active population. This activity constitutes the backbone of the country's economy (Wilfred *et al.,* 2016; Mouafor *et al.,* 2016). Due to its agro-ecological diversity, Cameroon has a great potential for agricultural production for its over 23 Million inhabitants and beyond, thus contribute towards feeding the world's nine billion people (Wilfred *et al.,* 2016). This sector ensures national food security, contributes enormously to the country's Gross Domestic Product (GDP), 15.28% and foreign exchange and above all provides raw material to the industrial sector (Mouafor*et al.,* 2016). Over 75% of Cameroons revenue comes from the sale of agricultural products (Lyonga and Ayuk, 2017).

The main food crops cultivated in the country are yam (*Dioscorea sp.* L), cassava (*Manihot esculenta*), potato (*Solanum tuberosum*) and sweet potato (*Ipomoea batatas*) which fall

under the category of roots and tubers (Nteranya, 2015). They are grown in varied agro ecological zones and production systems ranging from highland densely populated regions to low land drier areas prone to draught and floods. These four crops account for about 95% of the total root and tuber crop production in Africa. The aggregate value of these roots and tubers exceed all other African staple crops and much higher than the value of cereal crops. (Nteranya, 2015).

Potato (*Solanum tuberosum L*) is an important food crop which is widely grown in three of the five agro ecological zones in Cameroon (Njukeng *et al.,* 2013). Millions of farmers in the world depend on potato to enhance their livelihood (Mariette *et al.,* 2016). This food crop is grown in more than 130 countries in the world, covering about 18million hectares of land with an average yield of 17.4 tons per hectare as per the statistics of 2010. The yearly production of potato amounts to 295 million tons accounting for about half the yearly production of roots and tubers, one third of which comes from the developing countries (Njukeng *et al.,* 2013).

In Cameroon, potato is cultivated mainly in highland zones (altitude 1000 to 3000m above sea level) and in six of the ten regions of the country (Mariette *et al*., 2016). The West and the North West regions are the top potato producers with more than 80% of the 43,5354tons of the national production (Mariette *et al.,* 2016). The role of potato in the market economy of Cameroon has increased due to an increased demand for root and tuber foods from neighbouring countries like Gabon and Central African Republic and therefore represents a main source of income to the people in these regions (Njukeng*et al.,* 2013; Mariette *et al.,* 2016;).

However, the drop in world market prices and the consequent drop in the revenue obtained from the sale of coffee production of the 1980's ushered in new strategies to ensure food security (Zephania, 2014). This resulted in farmers seeking for different and alternative means of survival. Mixed cropping came in as alternative with potato being one of the crops cultivated (Zephania, 2014).

In the West region, both the conventional and organic systems are used to produce potato. Most often, the organic system is practiced and it is indispensable for production due to low organic matter content of the arable land (Tankou, 2014). Concerns about the sustainability of conventional agriculture in particular have promoted interest in farming alternatives that are more environmentally friendly (Crowder and Reganold, 2015) and contribute in internalizing the externalities posed by conventional agriculture (Srednicka *et al.,* 2016). Organic farming is the most popular alternative to conventional farming (Crowder and Reganold, 2015; Alawode and Abegunde, 2015). As more and more attention is being put on determining whether organic systems are more environmentally better or not, it is not clear whether organic agriculture could be economically attractive enough to trigger and spread adoption (Nemes, 2009). Whether organic agriculture can continue to expand will likely be determined by whether it is economically competitive with conventional agriculture (Crowder and Reganold, 2015).

This study was therefore aimed at comparing the performance between organic and conventional potato production in the West region of Cameroon in view of revising the economic policy. Two hypotheses were stipulated for this study: There is no difference in the yield of conventional and organic potato production in the West region of Cameroon and there is no difference in the cost, revenue and gross margins of conventional and organic potato production in the West region of Cameroon.

2. MATERIAL AND METHODS

2.1 Population, unit of analysis and sampling technique

In this study population refers to the conventional and organic potato producers in the West region of Cameroon. Both the purposive and snowball sampling technique were used. A total sample size of 200 respondents was identified, 148 conventional farmers and 52 organic farmers. Out of 200 farmers interviewed, 55 from Mifi division (11 organic and 44 conventional) and 145 from Menoua division (41 organic and 104 conventional). The total surface area of all farmers was calculated and farm output equally summed and yield was calculated on a per hectare basis. The unit of analysis was the individual potato farmer in the West Region who participated in this study.

2.2 Data collection and analysis

Quantitative and qualitative data from both primary and secondary sources were used for this study. Data from primary sources was collected directly from both conventional and organic potato farmers in the West region of Cameroon. The data was collected through face to face interview and well-structured questionnaires. Secondary sources of information from RECOSAF and MINADER, as well as different information included in works that have already been carried out in related fields of study and on the internet. Data collected included information on the production cost (pre-harvest and post-harvest labour, harvest labour, seedlings, manure, compost, treatments) and total revenue of the individual farmers. Data collected were entered into Microsoft Excel and exported into SPSS software program for statistical analysis.

3. RESULTS AND DISCUSSION

3.1 Socio economic characteristics of organic and conventional farmers

Table 1 presents the distribution of organic and conventional potato farmers according to their socio-economic characteristics. The results indicate that on the overall, majority of respondents were male (male 76% and female 24%). For conventional potato farmers, the male gender represented 70.3% while for organic potato farmers, 88.5% of the actors were male. Results indicate that there is no relationship between gender and the farming system practiced (R = 0.157). The dominance of men in potato production is in conformity with the findings of Rael *et al.* (2015) who stated that men are more involved in potato production due to their easy access to production resources and equally due to the fact that men have more physical strength to perform the tasks of land preparation, phytosanitary treatments and transportation of inputs to the farm as well as products out of the farm. This result is however contrary to the result obtained by Piebep et *al.* (2004) who stated that in the West region of Cameroon, potato production is mostly carried out by women. The smaller percentage of women involved in potato production can be attributed to the fact that agriculture is the main activity in the West region and everyone is involved irrespective of gender.

The study results for both organic and conventional farmers indicated that only a few people (4%) are engaged in farming activities above the age of 60 years. The findings revealed that a majority of farmers were aged between 41-50years (39.2% for conventional farmers and 30.8% for organic farmers) with a very weak relationship between age and the farming system practiced (R = 0.116). This result is in line with the findings of Basnayake and Gunaratne (2002) who stated that the age of a person is usually a factor that can explain the level of production and efficiency and that at an older age a farmer becomes less productive due to inadequate physical strength to perform agricultural activities. Mahenge (2014) in his results explained that at younger ages, many people prefer to do off farm activities in towns and cities because of shortage of land to cultivate. This finding is equally in line with the results of Rael *et al.* (2017) who stated that a majority of potato producers are in the age category of 31-45years because this age range is considered as the prime age for productivity.

Overall majority of farmers, 75.95% were married, specifically, 73% of conventional farmers and 78.9% of organic farmers were married. (R = 0.033, there is no relationship between marital status and the farming system practised). These results are in line with those obtained by Mahege (2014); Teendwa (2005); and Namwata *et al.* (2010) who stated that a greater percentage of married farmers can be attributed to the fact that the farmers want to reduce labour cost as the greater the family size, the larger the labour force hence, reduction in the labour cost.

These research findings indicated that 94.1% of the overall farmers were educated and specifically, 92% of conventional farmers and 87.8% of organic farmers had undergone formal education with a very weak relationship (R = 0.074) between the level of education and the farming system practiced. This result is also in conformity with those of Manu *et al.* (2014) with implications that educated farmers have the ability to undertake agricultural production systems and techniques and so they have the capacity to undertake agricultural production activities with fewer constraints.

A slight majority of the farmers (51.85%) had a household size of 5-8persons. Conventional farmers had a mean household size of eight persons while organic farmers had a mean household size of seven persons. About 81.1% of conventional respondents and 78.5% of organic respondents had a household size greater than 4 persons. (R= 0.055, there is no relationship between the household size and the farming system practiced).This result is in line with the results of Mahenge (2014) who found out that relatively larger family size is likely to enhance family labour supply on the farms hence, reducing cost of production and increasing yield.

The overall results revealed that 71.2% of farmers had farm sizes less than 0.5ha. However, all the organic farmers' have farms of less than 0.5ha while most conventional farmers (83.7%) produced on land of at most 1ha (Table 1) with some (16.3%) producing on land greater than 1ha. There is a weak correlation between potato farm size and the farming system practiced (R = 0.333). Organic farming is a labour intense system of production and need organic inputs which are bulky in nature in large quantities; therefore, it is evident to practice it on small surface areas. In addition, family members are the main source of labour used on farms. However, in case of larger surface areas, hired labour is sought.

Most farmers (61.5%) acquired their land through heritage. Findings further revealed that 59.5% of conventional farmers and 63.5% of organic farmers acquired their land through heritage, 33.8% of conventional farmers and 35.15% of organic farmers acquired their land through rents and 10% of conventional respondents purchased their farm land. (R= 0.074, there is a very weak correlation between the mode of acquisition of land and the farming system practiced). These findings are in line with those of Fon (2011) who revealed that 74.2% of rural women acquired land through heritage (family) and 38.5% through rentage. This author explained this result that married African women obtain land rights mainly through their husbands.

Research results revealed that 60.35% of farmers practiced livestock rearing as an income generating activity asides crop production. More specifically, 64.9% of conventional farmers and 55.8% of organic farmers practiced livestock rearing. The reason for this might be that, by-products like poultry dropping, goat droppings and cow dung are used in farms as manure. Meat from these animals equally serves as supplements in farmers' diet. Business ranked the second income generating activity besides agriculture. This can be explained by the fact that some farmers are equally involved in the sales of agricultural inputs like both mineral and organic fertilizers, pesticides and also equipment like sprayers, watering cans and ropes which are all necessary in the production of potato.

Overall results showed that 53.35% of farmers had less than five years of potato farming experience. Approximately 7% of conventional farmers had less than five years of experience and a majority of conventional farmers (40.5%) had 5-10 years of experience and 100% of organic farmers however had less than five years of experience. There is a strong correlation (R = 0.54) between the years of experience and the farming system practised. This is because organic farming in the West region of Cameroon is a recent domain and farmers are just getting into it. The fact that a majority of conventional respondents had between 5 and 15years of experience can be explained by the fact that most farmers are between 31 and 50 years old. At older ages they are no longer very productive and so stop the production activity.

Results revealed that 39.65% on the overall farmers produced potato once a year while 60.35% of the farmers produced potato twice a year. With respect to conventional farmers 78.4% cultivated potato twice a year while 21.6% cultivated potato once a year. Most organic farmers (57.7%) cultivated potato once a year while 42.3% cultivated potato twice a year. (R= 0.342, there is a weak correlation between the number of cropping seasons and the farming system practiced). The reason why most conventional farmers produced in two cropping seasons might be because potato production is their main source of income and therefore produce twice a year to maximise their output and hence revenue. Most organic (57.7%) farmers on the contrary produce potato once a year because of the long cycle of organic production due to no use of growth activators.

The survey results indicated that a majority of farmers (81.2%) had received training on potato production while just 18.8% had not received training (Table 1). As regards conventional farmers, 66.2% were trained farmers while 33.8 percent were not trained. With organic farmers on the other hand, 96.2% were trained while 3.8% were no trained. This result is in conformity with the findings of Nanfack (2018) who stated that majority of farmers had received training because of the fragile nature of the crop. It requires several phytosanitary treatments and so farmers needed to be trained on how to use such treatments in order to avoid cases of excesses or deficiency. Most organic farmers had received training on potato production because organic farming is a recent system of production in the West region of Cameroon and so farmers needed to be trained on how to get about it.

Results indicate that 76.5% of the overall farmers were members of farmers' organisation. However, 23.5% were not members of farmers' organisation. With respect to conventional farmers, 70.3% were members of farmers' organisations while 29.7% were not members. As concerns organic respondents, 87.7%were members of farmers' organisations while 17.3% were not members (Table 1). The reason why most respondents were members of farmers' organisations was because farmers sell their products through organisations. Also, farmers' adhesion to organisations is to facilitate the task of training as it is less expensive to train groups of producers than individuals. These findings are however in contrast to the findings of Nanfack (2018) who showed that 93.7% of farmers do not belong to farmers' organisations.

Hired labour comprised the main source of labour to conventional farmers (37.2%) while organic farmers mostly relied on family labour due to the fact that the cultivated areas are relatively small. There is a weak correlation (R = 0.268) between the sources of labour and the farming system practised. This can be explained by the fact that conventional farming is usually practiced on a relatively larger surface area and so labour is most often hired. The high percentage of conventional respondents with family as main source of labour can be explained by the fact that farmers usually have large families who are sufficient to supply the necessary labour needed in production. Only in cases of very large surface areas of

220 production that farmers call on hired labour which explains the 29% of labour from both
221 family and paid workers. On the other hand, organic farming has as main source of labour,
222 family.

223 **Table 1. Distribution of farmers according to their socioeconomic characteristics**

Socio economic characteristic		Conventional		Organic	
		Freq	%	Freq	%
Gender	Male	104	70.3	46	88.5
	Female	44	29.7	6	11.5
	Total	148	100	52	100
Age	21-30	18	12.2	13	25.0
	31-40	35	23.6	10	20.4
	41-50	58	39.2	16	30.8
	51-60	29	19.6	11	21.2
	>60	8	5.4	2	2.6
	Total	**148**	**100**	**52**	**100**
Marital status	Single	30	20.3	9	17.3
	Married	108	73.0	41	78.9
	Divorced	3	2.0	0	0
	Widow/widower	7	4.7	2	3.8
	Total	**148**	**100**	**52**	**100**
Level of formal education	None	12	8.0	2	3.8
	Primary	30	20.3	6	11.6
	Secondary	88	59.5	31	59.6
	Higher	18	12.2	13	25.0
	Total	**148**	**100**	**52**	**100**
Household size	1-4	28	18.9	11	21.5

(persons)	5-8	68	45.9	30	57.8
	9-12	40	27.0	9	17.3
	>12	12	8.2	2	3.4
	Total	**148**	**100**	**52**	**100**
Size of potato farm (Ha)	<0.5	64	43.2	52	100
	0.5-1	60	40.5	0	0
	1.1-1.5	22	15.0	0	0
	1.6-2	2	1.3	0	0
	>2	0	0	0	0
	Total	148	100	52	100
Mode od acquisition of agricultural land	Rent	50	33.8	19	36.5
	Inherited	88	59.5	33	63.5
	Bought	10	6.7	0	0
	Total	**148**	**100**	**52**	**100**
Sources of income	Livestock rearing	96	64.9	29	55.8
	Business	32	21.6	19	36.6
	Civil servant	12	8.0	2	3.8
	None	8	5.5	2	3.8
	Total	**148**	**100**	**52**	**100**
Years of farming experience	<5years	10	6.7	52	100
	5-10	60	40.5	0	0
	11-15	54	36.5	0	0
	16-20	17	11.5	0	0
	>20years	7	4.8	0	0
	Total	**148**	**100**	**52**	**100**

Number of cropping seasons	One	32	21.6	30	57.7
	Two	116	78.4	22	42.3
	Total	148	100	52	100
Training on potato production	Not trained	50	33.8	2	3.8
	Trained	98	66.2	50	96.2
	Total	**148**	**100**	**52**	**100**
Membership in farmers' organization	Members	104	70.36	46	87.7
	Not members	44	29.7	6	147.3
	Total	**148**	**100**	**52**	**100**
Sources of labor	Family	50	33.8	31	60
	Hired	55	37.2	18	35
	Family and hired	43	29.0	3	5
	Total	**148**	**100**	**52**	**100**

3.2 Yield disparity between organic and conventional potato production

The overall results indicate that conventional farmers had a total yield per hectare of 18,946.12kg ha^{-1} while organic farmers had a total yield per hectare of 17,668.1212kg ha^{-1}. More specifically, results revealed that conventional farmers in the Mifi division had a yield per hectare level of 9,284.1412kg ha^{-1} while organic farmers in the same division have a yield per hectare level of 890012kg ha^{-1}. Conventional farmers in the Menoua division had a yield per hectare level of 9,661.9812kg ha^{-1} while its organic farmers had a yield of 8,768.1212kg ha^{-1}. Results in Table 2 equally revealed that the yield per hectare of conventional farmers in the west region is greater than of the yield per hectare of organic farmers. The reason might be due to the use of growth regulators and other synthetic products to boost yield. These findings are similarto those of Fillipo *et al.* (2015) who brought to light the fact that conventional yields are higher (+21%) than organic yields. This result also indicates that the yield level of conventional farmers in Menoua division is greater than the yield level of conventional farmers in Mifi division. The reason could be that the climatic conditions more favourable for potato production in Menoua division. On the other hand, organic farmers in the Mifi division have a higher yield compared to organic farmers in Menoua division. This could be attributed to that organic farmers in Menoua division use low quality seeds from the previous production season, reason for the low yield. In order to verify the first hypothesis an independent sample t-test was conducted where the average yield level for conventional respondents was compared to that of the organic farmers.

Table 2. Yield gap of farmers per division

Division		Conventional	organic
Mifi	Output (kg)	340728	24920
	Surface area (ha)	36.70	2.80
	Yield (kg ha^{-1})	9284.14	8900
Menoua	Output (kg)	806196	12100
	Surface area (ha)	83.44	1.38
	Yield (kg ha^{-1})	9661.98	8768.12
	Total (kg ha^{-1})	**18946.12**	**17668.12**

3.3 Cost, revenue and gross margin disparities between organic and farming

3.3.1 Cost of production

This includes the land rent, pre-harvest labour cost; harvest labour cost, post-harvest labour cost, cost of seedlings, cost of manure, cost of fertilizers, cost of compost and cost of treatment. This is equally known as variable cost of production. Table 4 presents the total variable cost of production for organic and conventional potato production.

Results show that conventional farmers had a total variable cost of 131,493,450frs/Ha while organic farmers had a total cost of 9,947,450frs ha^{-1}. Independent sample t-test was used to compare the mean cost of conventional and organic farming systems. The t- value of 4.287 shows that the total costs of organic and conventional potato farmers are statistically different at 5% level of significance. This t-value rejects the null hypothesis which states that there is no difference in the cost of organic and conventional potato production. This result is contrary to that of Peter *et al.* (2011) who said that there is no difference in the production cost of organic and conventional farmers because they make use of similar production technologies.

3.3.2 Revenue of for potato production per production system.

The results indicate that conventional potato farmers had a total revenue of 194,680,000 F per production season with a total revenue per hectare of 1,620,442.82 F while organic farmers had a total revenue of 6,350,000 F with a total revenue per hectare of 1,519,138.75 F (Table 4). This can be explained by the fact that conventional farmers have a relatively higher output compared to organic farmers. It can equally be explained by the absence of organic markets. Farmers are therefore bound to sell their products at give-away prices. This result is contrary to that of Fillipo *et al.* (2015) who found out that organic yield is lower but their high sales prices make them to get higher income compared to conventional farming. Independent samples t-test was used to compare the revenue of the two production systems farmers. The t- value of 4.67 shows that the revenue of organic and conventional potato production is statistically different at 5% level of significance. This t-value rejects the null hypothesis which states that there is no difference in the revenue of organic and conventional potato production

Table 3. Total variable cost for conventional and organic potato production

Item	Variable cost (FCFA)

	Conventional	Organic
Land rent	3298000	165000
Pre-harvest labour	15962500	696500
Post-harvest labour	4074000	368500
Harvest labour	4437000	242500
Seedlings	69015000	5461000
Manure	11872000	887200
Fertilizers	14649150	0
Compost	0	1946750
Treatment	8185800	180000
Total	131493450	9947450

Table 4. Revenue of potato farmer

Item	**Revenue (Frs)**	
	Conventional	Organic
Total revenue (FCFA)	194680000	6350000
Surface area (Ha)	120.14	4.18
Total revenue per hectare	1620442.82	1519138.75

3.3.3 Gross margin of potato production

This was obtained by subtracting the total variable cost per hectare from the total revenue per hectare for the two systems. Table 5 presents the gross margins of potato production

The gross margin per hectare of conventional farmers was higher than that of organic farmers. This result contradicts the findings of Fillipo *et al.* (2015), who discovered that the higher revenue of organic farmers made them to have a higher gross margin compared to conventional farmers. Independent sample t-test was used to compare the mean gross margins of the two groups of farmers

The t- value of 4.408 shows that the gross margin of organic and conventional potato farmers' is statistically different at 5% level of significance. This t-value rejects the null hypothesis which states that there is no difference in the revenue of organic and conventional farmers.

Table 5. Gross margin of farmers

Item	Conventional	Organic
Revenue ha^{-1}	1620442.82	1519138.75
Total variable cost ha^{-1}	1094501.83	1207523.92
Gross margin ha^{-1}	**525940.99**	**311614.84**

297

298 ## 3.4 Challenges encountered by producers

299 Results show that both organic and conventional farmers had common problems. These
300 problems included poor seed quality, lack of support services, frequent attacks from pest
301 and diseases, rainfall variation (late rains which led to late planting) and no markets. For
302 organic farmers 80% indicated poor seed quality; 7% indicated attacks from pests and
303 diseases, 3% indicated lack of support services to farmers and 5% indicated non-availability
304 of markets as the main production constraints which greatly affected their output adversely.
305 Most conventional farmers (50%) indicated rainfall variability as the main production
306 constraint with late rains resulting to late planting. Also, 35% of these conventional potato
307 farmers indicated frequent attacks from pest and diseases due to the fact that some pests
308 have become resistant to the available pesticides. Moreover, 10% indicated insufficient
309 support services while 5% indicated lack of good quality seeds as the main production
310 constraints.
311
312 **Table 6. Distribution of farmers according to the challenges they encounter**

Challenges faced	**Conventional**		**Organic**	
	Frequency	%	Frequency	%
Low quality seeds	7	5	42	80
Insufficient support services	15	10	0	0
Pest and diseases	52	35	4	7
Rainfall variation	74	50	1	3
No markets	0	0	5	10
Total	148	100	52	100

313

314 ## 4. Conclusion

315 Both conventional and organic potato production in the West region of Cameroon are
316 affected by socioeconomic characteristics of the farmers. Most conventional and organic
317 potato farmers in this region are married men who had secondary education as their highest
318 level of education. Family labour is the main source of labour for production on farmland
319 mostly acquired through heritage.
320 There exist significant differences in the physical productivity levels of organic and
321 conventional farmers with conventional farmers having the higher output. There equally exist
322 a significant difference in the cost, revenue and gross margin of conventional and organic

potato producers in the west region of Cameroon. In addition to potato production, most farmers are involved in livestock rearing. It was equally observed that most organic producers in the region cultivated less than 500m^2 and equally that a hundred percent of organic farmers had less than less than five years of experience. This was attributed to the fact that organic farming is a recent system of production in the region. Based on all the parameters needed to measure economic performance, the conventional farming system emerged the most profitable system of production in the west region of Cameroon. Therefore, the regional or economic policy of improving livelihood through organic potato production should be re-examined by appropriate personnel in the appropriate departments of the country.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

This study was carried out in collaboration among all authors. Author FDE designed and proposed a protocole, outlined the structure and corrected the first draft of the manuscript. Author NNN collected and analyzed data and wrote the first draft manuscript. Author AHC proofread, revised and approved the final manuscript.

REFERENCES

1. Alawode O, Abegunde V. Economic cost and returns from organic farming in Oyo State, Nigeria. Journal of organic systems. 2015; 10(1):15-25.
2. Basnayanke B, Gunaratne L. Estimation of the technical and its determinants in the tea smallholding sector in the mid-country wet zone of Sri Lanka. Sri Lanka journalof agricultural economics. 2002; 4(1):137-150.
3. Crowder W, Reganold J. Financial competitiveness of organic agriculture on a global scale. PNAS. 2015; 112(24):7611-7616.
4. Filippo S, Matteo C, Mario F, Riccardo S, Riccardo T, Salvotore T. Economic and financial comparison between organic and conventional farming in Sicilian lemon orchards. Sustainability, MDPI, Open Access Journal. 2015; 7(1):947-961.
5. Fon D,E. Access to aerable land by rural women in Cameroon. Tropicultura. 2011; 29(2):65-69.
6. Lyonga S, Ayuk-Taken J. Collection, selection and agronomic studies on edible yams (*Dioscorea spp*) in Cameroon. International symposium on tropical root and tuber crops. 2017.
7. Mahenge J. Comparative economic analysis of conservational and conventional agricultural practices in Southern Uluguru Mountains, Mongoro, Tanzania. A dissertation in partial fulfilment of the requirements for the degree of masters of science in agricultural and applied economics of Sokoine University of agriculture. Monro, Tanzania. 2014.
8. Manu I, Tarla D, Chefor G. Effects of improved maize seed (*Zea mays* L) varieties on household and food security in the North West region of Cameroon. Scholarly journal of agricultural science. 2014; 4)5):265-272.
9. Mariette A, Gabriel K, Eric B, Gaston F, Nasser K, Theophile F, Hermann D, Funda A, Denis N. Characterization of potato (*Solanum tuberosum* L.) genotypes from the western highlands region of Cameroon using morphological and agronomic traits. Journal of plant scienes. 2016; 4(6):185- 194.
10. Mouafor B, Temegne N, Ngome A, Malaa D. Farmers' adoption of improved cassava varieties in the humid forest agro-ecological zone of Cameroon. Greener journal of agricultural sciences. 2016; 6(10):276-284.

11. Namwata B, Lwelemira J, Mzirai O. Adoption of improved agricultural technologies for Irish potatoes (*Solanum tuberosum*) among farmers in Mbeya rural district, Tanzania. A case of Ilungu ward. Journal of animal and plant sciences. 2010; 8(1):927-935.
12. Nanfack T. Evaluation de la durabilite des exploitations à base de pomme de terre dans le bassin de NdziihaBafou, Ouest Cameroun. Mémoire présenté en vue de l'obtention du diplôme d'Ingénieur agronome. University of Dschang. 2018.
13. Nemes N. Comparative analysis of organic and non-organic farming systems.A critical assessment of farm profitability. Food and agriculture organisation of the united nations, Rome. Agribusiness and economics. 2009;13: 124-130.
14. Njukeng P, Chewachong G, Sakwe P, Chofong G, Nkeabeng L, Demo P, Njualem K. Prevalence of six viruses in potato seed tubers produced in informal seed system in the North West region of Cameroon. Cameroon journal of experimental biology. 2013; 9(1):44-49.
15. Nteranya S. Root and tuber crops (cassava, yam, potato and sweet potato). 2015.
16. Peter U, Krisztina K, Zsuzsanna B. Cost and profit analysis of organic and conventional farming in Hungary. Journal of Central European Agriculture. 2011; 12(1):103- 113.
17. Piebep G, Clautilde T, David NgnokamFontem D. High efficiency of extracts of Cameroon plants against tomato late blight disease. Journal of agronomy for sustainable development. 2008; 28(4):567-573.
18. Rael J, Christopher O, Agnes N, Ki N. Socioeconomic characteristics of smallholder potato farmers in Mauche Ward of Nakuru County, Kenya. Universal journal of agricultural research. 2017; 5(5):257-266.
19. Srednicka D, Baranski M, Seal C, Sanderson R. Environmental impact of organic versus conventional agriculture. A review. Journal of research and application in agricultural engineering. 2016; 61(4):204-211.
20. Tankou CM. Effect of green manure and intercropping on potato production in the western highlands of Cameroon. International journal of scientific and technological research. 2014;3(9):204-208.
21. Teendwa A. Assessment of dairy production in Tanga region: farmers' awareness and adoption of the available technologies for improving feed quality. 2005, 166pp.
22. Wilfred A, Conalius E, Richard F, Ntungwe E. Agriculture in Cameroon, proposed strategies to sustain productivity. International journal of research in agricultural research. 2016;2(2):1-12.
23. Zephania N. Montane resource exploitation and the emergence of gender issues in Santa econ of the Western Bamontos highlandsn, Cameroon. International journal of geography and regional planning research.2014; 1(1):1-12.